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Ventech Systems Private Limi ted
Corporate Office: 409/410, Angel Mega Mall, CKl, Kaushambi, Ghaziabad-201010, Tel.: +91-120-4578855/ 4272075 • E-mail: info@ventechsystems.com
Registered Office: 511, Vikas Deep, Laxmi Nagar Distt. Centre, Vikas Marg, N.Delhi-92 (India),
Works : Plot No. B-13, Sector A-5/6, Tronica City, Loni - 201102, Ghaziabad (U.P.), India, Tel.: 09711003363

4272075 • E-mail: info@ventechsystems.com

1. INTRODUCTION

An Evaporative Air Cooling Plant is an economical substitute for Air-conditioning Systems to provide comfortable environment in places where dry and hot climatic Conditions prevail. There occurs no effective heat transfer from air in absolute terms, but it is only transformation of sensible heat energy of air into latent heat and as a result the dry bulb temperature of air reduces.

When the dry and hot fresh atmospheric air passes through cellulose fill chamber, the dense atomized/ water particles evaporate drawing the required heat energy for evaporation from the air stream as a result of which the dry bulb temperature drops substantially. However, as the water so evaporated is absorbed by the same mass of air the total heat energy content (enthalpy) of air remains unchanged, and it is essentially an adiabatic process as per the thermodynamic terminology.

The greater cooling effect of an evaporative Air Cooling Plant is felt, largely when the following conditions are available.

(i) Draft of cooled (humidified) air is directed over to the body of the workman, or in the working zone.

(ii) The stale air from the air cooled space is exhausted positively to the atmosphere outside using exhaust Fans. (This however holds goods if the sensible heat is less than 80%) or specially designed exhaust
air damper.

(iii) Outside atmospheric conditions are of high Temperature and relatively low humidity.

2. **EQUIPMENTS DETAILS**.

The offered Wet Ventilation system comprises the following principal equipments

Pre – Filters

These filters are to filter coarse atmospheric Dust in Felt & HDPE Combination.

Supply Air Blowers

The plant is provided with its supply air blower/s assemblies complete with driving and installation accessories. Every supply air blower assembly is suitably designed for handling the required air quantity of the air cooling plant independently or in association with other blowers which may be operating simultaneously.

Supply air blower is a double width type provided with double curved backward tip discharge bladed impellers of limit load design and provided in sheet steel fabricated construction suitable for V-belt drive arrangement,

Air Cooling Plant

This is of civil masonry construction and the internal accessories are provided as part of the ventilation equipments, which comprises of:

a) Fluted rigid media evaporative cooling pads.
b) Water distribution header
c) Water holding tank duly FRP lined.

Internal Piping

This is provided of MS class 'C' for inter connection of water sump to the pump inlet and pump discharge to the water header, complete with fittings, valves, and pot strainer for filteration of water in circulation in the system

Water re-circulating Pump

The water re-circulating pump motor set is of

	Centrifugal type configuration and of stable Head discharge characteristics (1 working & 1 standby).
Air distribution System / Accessories	Suitably designed supply air ducting net work is provided to distribute the cooled humidified air all over the space to be conditioned. The ducting is provided with supply air grilles / diffusers at suitable locations and branch duct dampers to balance the air flow, as required.

3. INSTALLATION

The air cooling equipments are to be placed in position and installed as per the specifications and details of the relevant equipment general arrangement and layout drawings.

Proper care shall be observed in maintaining the orientation of the equipment and its sequence.

It is of great importance to maintain the dimensions of the various sections of the plant to avoid equipment mismatch. Since most of the equipments are of fabricated nature, millimeter accuracies are generally not emphasized.

The fans/ blowers, pump – motor sets, and other foundation – mounted equipments are placed on the floating foundation blocks leveled properly and grouted through the foundation bolts. On curing of the grouting, the leveling blocks / packings shall be removed and equipments shall be accurately leveled using metal shims and tightened firmly.

The center to center distance between the pulleys shall be adjusted as per the requirement of belt tensioning by moving the tensioning bolts before installing the V-belts. The belt protection guards shall be provided over the drive arrangement, for protections against rotating pullies / belts.

The outlet of the fan shall be connected to the ducting / plenum openings by means of flexible canvas connection to eliminate transmission of vibratons, if any, from the fan to the static equipments / ducting.

The water re-circulation pump and motor set is also to be grouted after proper level adjustments. A precise alignment shall be done in case of horizontal split casing pumps used in direct – coupled arrangement with motor. The pipes are connected to the pump, without extra tensions on the connecting flanges.

The dry air filter cells are to be mounted on the filter frames.

4. STARTING & CHECK - UP

1. After completion of all erection activities, clean the air cooling unit thoroughly and check up for any loose materials lying in the Unit.

2. Check up all the bolts and nuts are tightened and rectify if found loose.

3. The fan motor shall be tested for electrical parameters (meggar tester) and if everything is normal run it for thirty minutes on no load.

4. Rotate the fan impeller and the motor shaft to confirm. The mechanical clearances and to ensure that the rotating parts are moving freely.

5. The direction of rotation of the fan motor shall be checked and corrected as required.

6. Check up the tension on the V-belts and adjust the center distance if required.

7. Check up the pump and motor also for electrical parameters and direction or rotation and correct them if required.

8. Fill the water sump with water up to the required level.

9. Start the pump motor set and bring the water pressure in the line to the required pressure.

10. The fan can also be trial run by closing the outlet, damper initially and opening it gradually, check and ensure the power consumption is within the limits of the motor rating. The door in the supply air plenum shall be kept opened for some time to blow out the air so handled out of the plant room.

11. Now the plant is ready for starting and start the equipments one by one maintaining the sequence of operation.

12. The supply air quantity shall be adjusted with the volume control damper in the supply air grilles.

13. The exhaust air flow shall be adjusted with the exhaust air damper provided in the exhaust / return air ducts.

5. PERIODICAL CHECKS TO BE CARRIED OUT

- The V-belts are to be checked for their tension after one weeks of running of the equipments.
- The fan bearing temperature is to be noted once everyday for the subsequent periods of working.
- Check up the pump and fan once in a day for any mechanical abnormalities.
- The water level in the water sump is to be checked up daily and replenished if necessary.
- The fan bearings shall be checked once at least in a period of 1 month for a 24 hours working plant. Fill up grease in bearing housing every fortnight.
- Check up the pump glands once in a week and adjust it or replace if required. However, leakage of water shall in no case be allowed to continue.
- Clean filters every month with a jet of compressed air.

6. MAINTENANCE TIPS AND GUIDELINES

Majority of problems reported by users of evaporative cooling pad based systems are basically due to improper treatment of water or misuse/management of water. The problems can be categorized as:

- Scale Formation
- Microbiological infestation
- Corrosion of support frame work, sump pumps etc.

Problems arising from mismanagement of water can be handled effectively by :

- Identifying type of water
- Water treatment

Types of water:

Natural water contains many soluble minerals and salts in different proportion, Based on the proportion of salt and mineral content, water can be classified as :-

- SOFT WATER
- HARD WATER

Hard water, normally, contains a higher concentration of mineral and salt. When water evaporates, it leaves behind a concentration of mineral and salt in form of a precipitate, which manifests itself as scale on the cooling pads.

Continuous build – up of these minerals, in form of scale, on the media surface restricts air flow and reduces the cooling efficiency. Additional fresh water is needed to dilute the high concentration of salts in the sump water if build – up is occurring.

As opposed to hard water, soft water is capable of leaching out the rigidifying agents and causing the pads to collapse.

TO AVOID BUILD UP OF SCALES, SOME OF THE RE-CIRCULATED WATER MUST BE REPLACED WITH FRESH WATER. THE FRESH WATER DILUTES THE CONCENTRATED SUMP WATER, THEREBY, MAINTAINING THE DESIRED WATER QUANTITY.

The water, which is replaced by fresh water is referred as bleed – off water.

Bleeding off, which is replaced, by fresh water is referred as bleed – off water.

Bleeding off some of the water is the most practical means of minimizing scale accumulation. Bleed-off prevents excessive concentration of minerals in the re-circulated water.

The bleed off rate should be 5% to 100% of the evaporation rate depending upon water hardness and air-borne contamination level.

Bleed – off rate fro general application should be set at 20% of maximum evaporation rate in extreme conditions.

A finish out cycle should be used that runs fresh water through the pad every 24 hours when the fan is switched off. This water should run for 3 minutes for every foot of medium height.

Regular inspection, to ensure that the bleed rate is adequate and is maintained, is a must.

Guideline

- Ensure PH range of 7.3 to 8 Water with extreme PH value is not suitable for cooling pads.
- Adjust the bleed off rate to ensure pH value does not cross the prescribed limit.
- Bleed off is referred to the rate at which the water is being removed from the sump to maintain the water quantity.
- Normally, bleed off rate is 20% of the evaporated water.
- Maintain the water quality.

Both **very** hard **and** very soft water is harmful and can adversely affect the life and performance of cooling pads.

Corrosion Control :

Corrosion is destruction of a metal by chemical or electrochemical reaction with its environment, during evaporative cooling, water circulating in the system is exposed to varying conditions and its composition changes, which increases its corrosive characteristics.

Corrosion can occur in pipelines, water sump, water pump water distribution channel causing damage, or destruction of the equipment, or excessive rapid wear of moving parts such as pumps. Corrosion can reduce cooling efficiencies and create water flow blockages.

Corrosion related damages can be minimized by the following :

- Using corrosion resistant construction materials
- Providing protective coating periodically to separate the water from the metal surfaces of the equipment.
- Adding corrosion inhibitors and pH control chemicals to water or removing oxygen from the water.

PH is defined as logarithm of the reciprocal of the hydrogen ion concentration of a solution. If pH value is less than 7. the water is considered as acidic and if pH value is more than 7, water is considered as alkaline.

Corrosion treatment of cooling water is done through use of chemicals like blends of phosphate, phosphonate, molybendate, zinc, silicate, and various polymers for corrosion control.

Installation Guidelines

A. **Frame Work**

1. Top

- Water distribution
- prevent air bypass

2. Sides

- Prevent air bypass
- Keep pads together

3. Bottom

- Prevent air bypass
- Support pads 50% minimum
- Do not allow pads to sit in water

4. Other

- Keep pads in place

B.. **Operation**

1. Allow pads to dry out once per day

2. Allow fans to run after pump is off for an hour

3. Bleed – off equal to 10% of total water rate

4. Maximum velocities (air flow)

MAINTENANCE GUIDELINES FOR FANS:

Please refer separate manual for Centrifugal Blowers attached.

WHY CHOOSE EVAPORATIVE COOLING

Most industries today can't justify the cost of conventional air – conditioning, even though they are increasingly concerned for the quality of the indoor environment and know that hot summer conditions cause increased instances of heat-related illness, increased absenteeism and lowered productivity.

Evaporative Cooling, particularly with the highly efficient Cellulose media used in today's equipment, is the perfect answer for most Industries. "Evaporative Cooling can alleviate these heat problems and contribute to worker efficiency with improved employee morale. Without it, increased absenteeism, high labour turnover and danger to health and safety can be experienced during the summer months. Production decline in uncooled plants may range from 25% to 40% of normal on hot days".

Evaporatie Cooling has been literally used for thousands of years for comfort cooling and is still commonly used around the world in a variety of locations and applications because of its Simplicity, Effectiveness and Low Cost. Any one who has experience in HVAC design for facilities in more arid climates probably is familiar with and has used Evaporative Cooling for years.

Many owners and designers in other climate are not aware that "…. Dry bulb temperature reduction due to the evaporative of water always results in lower effective temperature, regardless of the relative humidity level' and that …. " Evaporative Cooling can provide relief cooling of factories almost regardless of geographical location".